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## RELIEF 12-01 Draft Report

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Monterey, California: Naval Postgraduate School

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# RELIEF 12-01

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Draft Report  
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## Introduction

The ninth meeting of the Research and Experimentation for Local and International First Responders (RELIEF) experiments took place from 2-5 November 2011 at Camp Roberts in Paso Robles, CA. Over 40 people from 17 organizations in the disaster response community participated in 10 planned experiments. Most work centered on a core problem in humanitarian assistance/disaster response operations: how to fuse data collected from crowdsourcing, maps, and sensors into a sense of shared situational awareness *across* organizations.

Because the structure of RELIEF allowed for *ad hoc* experiments, participants created 10 unplanned experiments that tested the interoperability of their platforms.

## Participating Organizations

- **Camp Roberts Emergency Services:** the fire and rescue services department for the base.
- **Geocent:** a platform that allows for dynamic fusion of multiple common operating pictures and interoperable data exchanges across GIS platforms.
- **GeoIQ:** a geospatial data management, visualization and analysis platform providing collaborative, browser-based data analysis tools for use by both technical and non-technical users.
- **Humanity Road, Inc.:** A nonprofit organization dedicated to educating the public with critical recovery information before, during and after a catastrophic disaster, and one of the organizations that engage in the management of crowdsourced data during disasters (focused on the early response).
- **Knowledge Bridge International:** a Reston-based corporation that builds hardware and software solutions for humanitarian/disaster response operations and military operations.
- **Lockheed Martin Corporation Universal Communications Platform:** From Lockheed Martin, a system that integrates all types of fixed and mobile radio systems and enables interoperability with other communications and data-related systems.
- **MedWeb:** a telemedicine system used extensively by NGOs and the military.
- **Monterey County CERT:** the FEMA-sponsored CERT team for the county in which Camp Roberts is situated.
- **National Defense University:** the co-host of the RELIEF event.
- **Naval Postgraduate School:** the host of the RELIEF event.

- **Naval Surface Warfare Center – Dahlgren Division:** the OSD- and Joint-Staff-sponsored QuickNets team, building a deployable crowdsourcing application for HADR/SSTR applications.
- **NowForce:** a Maryland corporation that builds a dispatch and mobile responder system for search and rescue (SAR) teams.
- **Range Networks, Inc.:** a California corporation that builds OpenBTS, an open-source software cellular system.
- **Rogue Genius LLC:** a California corporation with one of its specialties being in the security of crowdsourcing platforms.
- **Synergy Strike Force:** a non-profit international network of synergists who facilitate information sharing in Afghanistan and other HADR/SSTR contexts.
- **UA Vision LLC:** An Ohio corporation that builds and operates small, low-cost UAVs that include payloads for reading RFID chips from the air.
- **United Hatzalah:** An Israeli search and rescue team that deployed to Haiti.

## Tracks

1. Communications Systems
2. Sensor Platforms
3. Crowdsourcing TTPs
4. Emergent Experiments

### Track 1: Communications Systems

Disasters require determining the status of people and assets and then coordinating their actions. Sensors and communications networks are critical infrastructure for this task. However, as shown in Haiti, restoring and maintaining communications networks present several challenges:

1. Disasters degrade or destroy existing commercial communications systems, often requiring response organizations to provide their own systems during the period when telecommunications companies are restoring regular services. However, these secondary systems are rarely made in ways that allow for easy interoperability. Responders consequently find that they need to develop channels for connecting with their peers at other organizations, and often resort to using lowest common denominator approaches like text messaging.
2. Any surviving commercial infrastructure faces an initial surge in demand from a populace that is trying to ascertain the status of families, friends, and colleagues, followed by a surge of communications from the communities that are participating in the formal and informal response operations.
3. Crowdsourcing is placing additional demands and importance on the maintenance of short-message services (SMS/text messages), which often

use the signal channel for voice services. This signal channel can become overwhelmed by the surge of voice calls in problem (2) above, affecting the viability of SMS/text messaging services as well as crowdsourcing platforms that rely on SMS/text messaging services.

Two separate experiments tackled parts of this challenge:

### **Lockheed Martin Company Universal Communications Platform (UCS)**

The UCS provided a mechanism to establish and interconnect stand-alone (non-commercial) 2G and 3G cellular services, along with UHF and VHF services—all with VSAT backhaul. The system is designed to bridge all these services, so that individuals on VOIP/Skype, UHF/VHF radio, and cell phones can all engage in a single, unified conference call. Lockheed provided cellular services to both QuickNets and NowForce, establishing cellular connectivity for collection of data using SMS on 2G and using an Android-based application on the 3G network. It should be noted that Lockheed helped NowForce learn that 2G data services are insufficient to support their Android-based field data collection needs, and required 3G services.

### **Range Networks/OpenBTS**

Working with MedWeb, Range Networks setup their OpenBTS cellular system using a self-contained, solar-powered 1w cellular base station (a full CAL). The team learned that system was capable of being supported by a small BGAN for backhaul to the Internet (it had initially been supported by a VSAT), enabling the system to fit in a small form factor and be completely self-supporting.

## **Track 2: Integration of UAV, Sensor Platforms, and EOCs**

For humanitarians, the ability to pull UAVs and sensor data into a common operational picture has long been a desired capability. UAV platforms and the sensors that they carry can contribute to situational awareness not only through imagery, but also by providing a channel for connecting with other radio devices and delivering communications gear to remote disconnected sites.

However, UAV and sensor assets are closely associated with military ISR organizations and have therefore presented difficulties for NGOs that try to deploy them during complex operations. Host nation governments tend to view the use of such assets as an act of “intelligence collection” and a violation of humanitarian principles of neutrality and non-alignment by NGOs and UN agencies. As a result, humanitarian EOCs often have far more static maps and text-based reports than dynamic, real-time views of an unfolding situation.

As a result, much of the UAV experimentation at Camp Roberts tends to look towards future deployment of UAV assets, some of which may involve military

support to humanitarian organizations, some of which look towards the humanitarian EOC of the future. Four experiments extended the capabilities of UAVs and sensor platforms for humanitarian uses:

- **Lockheed Martin EOC.** Integrating a mast-mounted camera with a Universal Communications Platform and a video system providing live video over minimal bandwidth both to and from cell phones over 2G networks.
- **UAVision.** A low-cost small UAV with RFID-reader payload for scanning cargo spread over a large area, such as an airfield (a problem in Haiti).
- **Blizzard Fielded Integrated Quick-Response UAS-Based Aerial Delivery System:** a parafoil system for delivering small payloads dropped from a UAV within a 10m landing zone.
- **Knowledge Bridge International:** A low-cost balloon-mounted COTS camera system for providing hovering situational awareness over a small area.

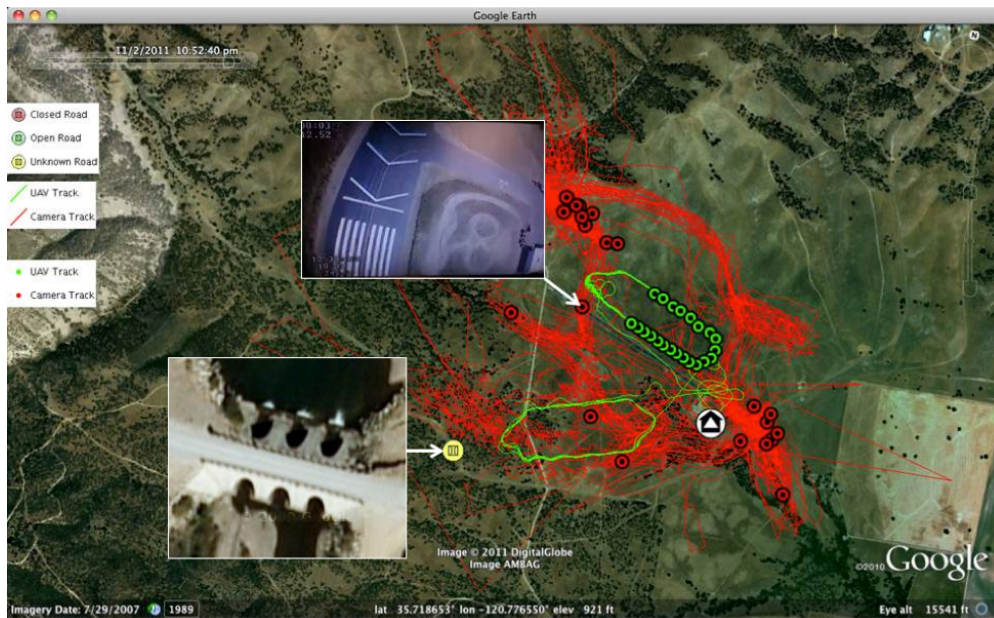
### Lockheed Martin Emergency Operations Center (EOC)

Lockheed Martin integrated its UCS with a number of camera and cellular systems to enable responders to view and exchange voice, video, and still imagery over a wide variety of communications devices. Lockheed mounted an electro-optical/infrared (EO/IR) camera on a 20-ft mast to provide responders with a crow's-nest view of the airfield. The pan-tilt-zoom functions of the camera could be controlled using 2G and 3G cell phones remotely, and the video sent over cellular network—notably using a compression algorithm that enabled 2G phones to receive video from the mast-mounted camera—to operators who did not have line-of-sight view of the camera.

Lockheed also integrated video received from 2G and 3G cell phones into its EOC, providing responders with the ability to integrate video collected from the crowd and from responders' own cell phones into the view seen by an ICS commander or joint humanitarian operations center.

### UA Vision UAV

UA Vision demonstrated a small UAV capable of maneuvering through high-winds (40k+). The UAV provided a live-downlink of its fixed EO camera along with metadata that GeoCent integrated into a dynamic map of both the UAV's position and the center point of where the camera was pointing.



The UAVision bird was also capable of reading RFID chips placed in cargo. While the test for this capability was not formally tested at RELIEF 12-01, the feature could be critically important to quickly reading data from large supply chains, particularly if the lead for the international humanitarian logistics cluster, the World Food Programme (WFP), could enforce a standard around RFID chips for heterogeneous supplies sent to large humanitarian operations.

### Snowflake UAS-based Aerial Delivery System

The ability to deliver a payload to a location has seen an order of magnitude increase in accuracy in recent years. One of the systems demonstrated by NPS is Blizzard, a parafoil-based delivery system whose autopilot and guidance system has repeatedly shown the ability to deliver small payloads dropped from ~3000' AGL within a target area of 30'. In a lunchtime brief, RELIEF participants explored the idea of using this system to drop a system of network nodes (Wifi, cellular, and/or WiMAX) on strategic hilltops to blanket a theatre of operations in network connectivity. This capability would radically alter the communications challenges faced by NGOs that arrive in an austere place after a natural disaster. NDU/TIDES would like to explore the development of this capability for humanitarian organizations in future RELIEF experiments.

### Knowledge Bridge International Airborne Situational Awareness Platform

In many circumstances, humanitarian organizations cannot obtain permission to fly UAVs. That said, balloons often present fewer problems, especially when flown over a logistics base or IDP camp. Knowledge Bridge International flew a low-cost balloon over the forward-operating base (FOB) located on Camp Roberts. The balloon had a COTS camera that collected data over the course of an afternoon. Because of insurance regulations, the balloon had to be transferred to an entity that



had insurance that met Camp Roberts requirements. The data will be used to train NLP algorithms for pattern detection.

### **Track 3: Crowdsourcing and Situational Awareness Platforms**

From Haiti to Honshu and North Africa, crowdsourcing has shown incredible promise. Grassroots activists, protestors, and citizens reacting to natural disasters have all shown the power of coordinating action based on data exchanged via SMS/test messages. What is less proven is how to integrate the data collected by citizens into the official response operations. How does one ensure that the data are valid, consistent, and reliable?

Several experiments examine a special case of crowdsourcing: how to apply citizen-generated data to the dispatch of search-and-rescue assets.

- QuickNets: a deployable crowdsourcing platform from NSW Dahlgren. Operated in conjunction with Humanity Road, a non-profit volunteer and technical community (V&TC) that assists with the collection of crowd-generated disaster data.
- GeoIQ:
- GeoCent:
- NowForce Field Data Collection:
- NDU/Rogue Genius Security Risks and Mitigation Practices Session

#### **QuickNets**

After Haiti, OSD and Joint Staff funded a project to build a deployable instance of crowdsourcing software. Based on Ushahidi, the Quicknets project from NSW Dahlgren demonstrated two capabilities:

- Microtasking: the ability to channel messages received from the crowd into an assembly line that a smaller, bounded crowd triages and processes through a series of steps, including validation, translation, and geolocation.
- Brokering/dispatch: a tool to enable responders to view validated and geolocated messages and to dispatch resources to meet the request or emergency described within each citizen-generated report.

QuickNets successfully demonstrated both microtasking and brokering at Camp Roberts. Volunteers submitted reports via SMS from across the base over several commercial and non-commercial cellular networks, leaving a ribbon with a unique number and description in the spot from which they sent the SMS. Volunteers also sent junk messages which were deliberately not actionable. The QuickNets team then partnered with Humanity Road (HR) to run a microtasking process. HR's smaller crowd—which was spread over several states and countries—separated hundreds of junk messages from those which were actionable, then geolocated



those messages based on described landmarks on the base and available public satellite imagery of the base.

On a subsequent day, a member of the Camp Roberts Fire and Rescue team then dispatched volunteers to events identified by HR as actionable, with the goal of retrieving the corresponding flag left in that location. The microtasking process and the dispatch process showed great promise, working well in most circumstances and even passing the hurdle of geolocating vague geographic references into roughly accurate GPS coordinates. The dispatch process does need to provide additional tools to aggregate reports from a given zone and assign to a single SAR team. The dispatch process also needs a method for display the urgency and status of requests, as well as an interface design that matches the needs of seasoned 911 emergency dispatchers.

### GeoIQ

GeoIQ is a geospatial platform that enables rapid aggregation and analysis of datasets into dynamic maps without assuming any substantial GIS expertise. GeoIQ participated in the QuickNets experiment, providing visualization of the reports submitted by volunteers. It also ran its own field data collection experiment, with an Android application that enabled responders to submit the GPS coordinate along with information collected within a flexible field-data collection form. Importantly, the GeoIQ Mobile application tracked the status of reports in real time, and enabled responders to change the status of a report from the field. The team at the EOC was able to view changes to the status of reports in real time, as well. Both GeoIQ TIDES would like to explore the extension of this functionality to dispatching SAR assets based on live Twitter streams.

### GeoCent

GeoCent provides a geospatial platform that aggregates data from disparate and often incompatible common operating pictures into a flexible, dynamic view. GeoCent proved that it could aggregate data from a live UAV video feed with the reports submitted by GeoIQ, NowForce, and QuickNets, placing all these data points onto a single map (visualized in Google Earth). This capability is a critical bridge, especially for dynamic data such as social media and UAV video. TIDES would like to explore scenarios that will extend the functionality of GeoCent for humanitarian response EOCs, and which will demonstrate aggregation of maps from organizations with varying abilities with GIS.

### NowForce Responder

NowForce provides a dispatch/responder application that connects EOCs with fielded SAR teams via a smart phone application. NowForce Responder connects the mobile application with a web-based platform that provides a dispatcher with an overall view of the position of teams, as well as a visualization of reports with their status. Teams and the dispatcher are in constant contact with instant messaging over the cellular network. NowForce ran a parallel field data collection process with QuickNets, mapping mock casualties that the team from United Hatzalah (an Israeli

SAR team) submitted from the field and dispatching teams to those locations. NowForce attempted to use the 2G network established by Lockheed Martin, and in the process discovered that their mobile application requires 3G to be effective. TIDES is interested in understanding how to connect this tested dispatch system with other platforms via open APIs and data exchanges.

### Crowdsourcing Security

In Mexico, leaders of social media activities that expose cartel activities are being systematically murdered. In the Middle East, governments are hacking social media web sites and cellular systems to discover the identities of key grassroots activists. In this light, the crowdsourcing's honeymoon is over. The platforms and practices used to collect data from the crowd must now undergo a fundamental security review.

Through a lunchtime briefing with George Chamales of Rogue Genius and Sam Bendett of NDU, RELIEF participants explored ten vulnerabilities to crowdsourcing networks, ranging from the security of the cellular and internet networks to the practices used by grassroots leaders. The most important output from the conversation was the need to develop a common set of security standards and practices that grassroots leaders can follow in the deployment of crowdsourcing applications, and the need to constantly red team these standards to keep them up to date in relation to the tactics being used by those who wish to do harm to the vulnerable. TIDES would like to pursue the development of these security standards in subsequent RELIEF events, and to publish these standards on an ongoing basis.

### Track 4: Emergent Experiments

Although the primary mission of RELIEF is to provide a venue for planned experiments, the proximity of committed, brilliant engineers inevitably leads to mashups and experiments which no one could have planned ahead of the experience in the field. In many cases, the activity of troubleshooting leads to dinner conversations between engineers at different organizations, and often leads to solutions which none had previously envisaged. As with each previous RELIEF experiment, at least nine of these emergent experiments occurred at RELIEF 12-01 (several more occurred, but were not necessarily captured in the formal record).

1. **BGAN-Backed Cell Site.** Range Networks worked with QuickNets to demonstrate that their small cellular node could use BGAN as a backhaul to the Internet, a capability that is much smaller, cheaper, and lighter than the VSAT solution they began with.
2. **Geocent/UA Vision I:** GeoCent partnered with UAVision to solve one of the core problems in making use of imagery from small UAVs without automated imagery processing software: how to show the difference between the position that the UAV autopilot embeds in the metadata of each picture and the position on the ground at which the UAV camera is actually pointing. This

delta is critical for mosaicking the imagery, especially when the autopilot reports that a vector of travel that is different from the angle at which the aircraft is actually pointing (as happens with yaw in high winds). GeoCent developed a map (shown above in their experiment) to track both the position of the UAV and the center point on the ground at which the camera is pointing.

3. **Interactive Data Layer with GeoIQ.** GeoCent also partnered with GeoIQ to provide a dynamic visualization of the data collected using GeoIQ's mobile application.
4. **Cellular Connectivity for NowForce:** The discovery that NowForce Responder mobile application only works properly when on a 3G connection was due to an unplanned experiment between Lockheed and NowForce. Lockheed provisioned standalone 2G and 3G cellular networks and registered NowForce's smart phones for use on those networks, providing NowForce with an environment unaffected by commercial carrier data services. This opportunity enabled NowForce to test their gear with equipment that would normally be far outside the budget of a small company.
5. **Google Earth Server and GeoCent Layers.** GeoCent is not just an aggregator of data; it also offers outbound data services. Lockheed connected their Google Earth Enterprise server with GeoCent, displaying KML in their EOC.
6. **Remote Disaster Node for QuickNets:** Using its UCS, Lockheed provided non-commercial cellular coverage to QuickNets, proving that the application could work in an environment where cellular networks have been destroyed and responders have established their own standalone cellular networks. This worked on both 2G and 3G. TIDES and Lockheed would like to explore a smaller version of the UCS that could be packed into Pelican cases and deployed as part of the PEAK JCTD.
7. **Micro tasking – Dispatch/Rescue Broker at the EOC.** While QuickNets had planned on testing the brokering capabilities, it had not planned on having a seasoned firefighter and SAR expert run the dispatch operations. With the generosity of the Camp Roberts Emergency Services department, QuickNets was able to test TTPs with Lee Elliot of Camp Roberts Emergency Services
8. **NPS Remote Sensing Center Integration.** Based on a visit from NPs Remote Sensing Center, RELIEF discovered that many of its common operational picture experiments could benefit from the imagery TTPs that NPS is developing. TIDES would like to partner around the integration of crowdsourcing data as signals for imagery collections with NPS.

9. **UA Vision Collaborations.** UA Vision was generous with their time. They partnered with Knowledge Bridge International around the development of better imagery stabilization algorithms. They also flew missions with their UAV to provide data on a bridge over a river to the QuickNets dispatcher (proving the integration of UAV assets into the crowdsourcing brokering process), and flew a mission to enable Lockheed to calibrate their 9mm camera tracking system.